Health Canada | Santé Canada
Pest Management Regulatory Agency | Agence de réglementation de la lutte antiparasitaire

Proposed Re-evaluation Decision PRVD2007-02

Re-evaluation of Oxamyl

The purpose of this document is to inform registrants, pesticide regulatory officials and the Canadian public that Health Canada's Pest Management Regulatory Agency (PMRA) has re-evaluated oxamyl for use as an insecticide, an acaricide and a nematicide in terrestrial food crops. This Proposed Re-evaluation Decision document provides a summary of the data and information reviewed as well as the rationale for the proposed re-evaluation decision.

The PMRA is proposing that the use of oxamyl and associated end-use products is acceptable for continued registration. Additional mitigation measures to further protect workers and the environment are identified in this document.

By way of this document, the PMRA is soliciting comments from interested parties on the proposed re-evaluation decision for oxamyl. The PMRA will accept written comments on this proposal up to 60 days from the date of publication of this document to allow interested parties an opportunity to provide input into the proposed decision. All comments should be forwarded to Publications at the address below.

(publié aussi en français)

9 July 2007

This document is published by the Health Canada Pest Management Regulatory Agency. For further information, please contact:

Publications
Pest Management Regulatory Agency
Health Canada
2720 Riverside Drive
A.L. 6605C
Ottawa, Ontario
K1A 0K9

Internet: pmra_publications@hc-sc.gc.ca
www.pmra-arla.gc.ca
Information Service:
1-800-267-6315 or 613-736-3799
Facsimile: 613-736-3758

Canada

ISBN: 978-0-662-46342-9 (978-0-662-46343-6)
Catalogue number: H113-27/2007-2E (H113-27/2007-2E-PDF)

© Her Majesty the Queen in Right of Canada, represented by the Minister of Public Works and Government Services Canada 2007

All rights reserved. No part of this information (publication or product) may be reproduced or transmitted in any form or by any means, electronic, mechanical photocopying, recording or otherwise, or stored in a retrieval system, without prior written permission of the Minister of Public Works and Government Services Canada, Ottawa, Ontario K1A 0S5.

Executive Summary

Health Canada's Pest Management Regulatory Agency (PMRA) has re-evaluated the available information on the active ingredient oxamyl and the associated end-uses on terrestrial food crops. The PMRA is proposing that the use of oxamyl and its end-use products is acceptable for continued registration with the implementation of additional mitigation measures to further protect workers and the environment.

The major mitigation measures are proposed as follows.

- Personal protective equipment is required when handling products containing oxamyl. Custom application to potatoes requires additional mitigation when handling more than 110 kg a.i./day using closed mix/load equipment (with coveralls and gloves) and closed cab ground application equipment.
- Restricted-entry intervals of one day for non-bearing apple trees and of three days for raspberries and potatoes are required.
- The maximum application rate for foliar application to non-bearing apple trees must be reduced from 2.244 kg a.i./ha to 1.68 kg a.i./ha.
- The number of applications must be restricted to 2 per season for potatoes and 3 per year for non-bearing apple trees with a minimum interval of 14 days.
- For bees, risk could be reduced by restricting the application of oxamyl to when bees are not actively foraging.
- Observance of buffer zones is required to protect non-target aquatic habitats from spray drift.
- Advisory statements as precautionary measures are required on product labels to minimize the risk of aquatic contamination from surface runoff.

Table of Contents

1.0 Introduction 1

2.0 Re-evaluation of Oxamyl 1
- 2.1 Chemical Identification 1
- 2.2 Physical and Chemical Properties of the Active Substance 2
- 2.3 Description of Registered Oxamyl Uses 2

3.0 Effects Having Relevance to Human Health 2
- 3.1 Toxicology Summary 2
- 3.2 Occupational and Residential Risk Assessment 4
  - 3.2.1 Toxicology Endpoint Selection for Occupational and Residential Risk Assessment 4
  - 3.2.2 Occupational Exposure and Risk Assessment 4
  - 3.2.3 Residential Exposure and Risk Assessment 7
- 3.3 Dietary Exposure and Risk Assessment 7
  - 3.3.1 Acute Dietary Exposure and Risk Assessment 7
  - 3.3.2 Chronic Dietary Exposure and Risk Assessment 8
  - 3.3.3 Drinking Water Exposure 8
- 3.4 Aggregate Exposure and Risk Assessment 9

4.0 Environmental Assessment 9
- 4.1 Environmental Fate 10
- 4.2 Environmental Toxicology 10
- 4.3 Drinking Water Concentrations 10
- 4.4 Terrestrial Assessment 11
- 4.5 Aquatic Assessment 12
- 4.6 Environmental Assessment Conclusions 13
- 4.7 Environmental Risk Mitigation 13

5.0 Value 14

6.0 Other Assessment Considerations 14
- 6.1 Toxic Substances Management Policy 14
- 6.2 Formulant Issues 14

7.0 Proposed Regulatory Action 15
- 7.1 Proposals Pertaining to Toxicology 15
- 7.2 Proposals Pertaining to Occupational/Residential Exposure 15
- 7.3 Proposals Pertaining to Dietary Exposure 15
  - 7.3.1 Residue Definition 15
  - 7.3.2 Maximum Residue Limits of Oxamyl in Food 16
- 7.4 Proposal Pertaining to Drinking Water 16
- 7.5 Proposals Pertaining to Environment 16

8.0 Additional Data Requirements 17
8.1 Additional Data Requirements Related to Toxicology 17
8.2 Data Requirements Related to the Dietary Exposure Assessment 17

9.0 Proposed Re-Evaluation Decision 17

List of Abbreviations 19

Appendix I Oxamyl Products Currently Registered (excluding discontinued products or products with a submission for discontinuation) as of 6 January 2006 21

Appendix II Registered Canadian Uses of Oxamyl as of 6 January 2006 23

Appendix III Toxicology Endpoints for Oxamyl Health Risk Assessment 25

Appendix IV Occupational Exposure Estimates 27
Table 1 Occupational Mixer/Loader/Applicator Exposure and Risk Assessment 27
Table 2 Postapplication Exposure Estimates, MOEs and REIs for Oxamyl 28

Appendix V Dietary Risk Assessment 29
Table 1 Acute and Chronic Dietary Risk in the United States and Canada 29
Table 2 Drinking Water Level of Comparison for Oxamyl 29
Table 3 Probabilistic Estimate of Risk Due to Drinking Water Exposure 30

Appendix VI Label Amendments for Commercial Class Products Containing Oxamyl 31

1.0 Introduction

Health Canada's Pest Management Regulatory Agency (PMRA) announced in August 2002[1] that selected carbamate active ingredients, including oxamyl, were subject to re-evaluation under the authority of Section 19 of the Pest Control Products Regulations.

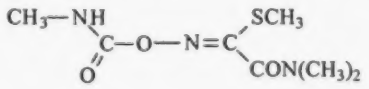
This document includes a human health assessment, an environmental assessment and information on the value of oxamyl to pest management in Canada.

2.0 Re-evaluation of Oxamyl

Oxamyl is a broad spectrum, Resistance Management Group 1A (carbamate) insecticide, which inhibits acetylcholinesterase. It works by contact as well as ingestion and has systemic action.

Much of the scientific information used by the PMRA in its assessment of oxamyl came from the registrant, United States Environmental Protection Agency (USEPA) reviews and the USEPA Interim Reregistration Eligibility Decision (IRED) document for oxamyl dated in December 2000 as well as previous PMRA reviews. The IRED document as well as other information on the regulatory status of oxamyl in the United States can be found on the USEPA's website at www.epa.gov/pesticides/op/status.htm.

2.1 Chemical Identification

Active substance:	Oxamyl
Function:	Insecticide, acaricide, nematicide
Chemical names:	
IUPAC:	*N,N*-dimethyl-2-methylcarbamoyloxymino-2-(methylthio)acetamide
CAS:	methyl 2-(dimethylamino)–[[(methylamino)carbonyl]oxy]-2-oxoethanimidothioate
Chemical class:	Carbamate
CAS Number:	23135-22-0
Molecular formula:	$C_7H_{13}N_3O_3S$
Molecular weight:	219.3
Structural formula:	

Identity of Relevant Impurities to Human Health or Environmental Concern
In 1987, nitrosamines were detected at < 0.4 ppm (limit of detection: 0.1 ppm) in one of six samples analyzed. It is unlikely that this trace level of nitrosamines would pose a health risk to humans. However, the PMRA will require analysis of current technical material for contaminants to ensure minimal levels.

---

[1] Re-evaluation Document REV2002-06, *Re-evaluation of Selected Carbamate Pesticides*.

2.2 Physical and Chemical Properties of the Active Substance

Property	Result
Vapour pressure at 25°C	0.051 mPa
Henry's law constant	3.9×10^{-8} Pa m^3mol^{-1}
Ultraviolet (UV)–visible spectrum	Not expected to absorb UV at $\lambda > 290$ nm at pH < 2, 7 and >10
Solubility in water at 25°C	280 g/L
n-Octanol–water partition coefficient	Log K_{ow} = -0.44 (pH 5)
Dissociation constant	Not available

2.3 Description of Registered Oxamyl Uses

Appendix I lists all oxamyl products that are registered in Canada. Appendix II lists all the uses for which oxamyl is presently registered. All uses are supported by the registrant and were considered in the health and environmental risk assessments of oxamyl. Clarification by both the registrant and provincial specialists supports a rate reduction from 2.244 kg a.i./ha to 1.68 kg a.i./ha for the foliar application to non-bearing apples.

Uses of oxamyl belong to Use-Site Category 14: Terrestrial Food Crops.

3.0 Effects Having Relevance to Human Health

3.1 Toxicology Summary

Pharmacokinetic studies indicate that oxamyl is readily absorbed and does not accumulate in any tissues. The prominent route of excretion was via the urine, with only a small amount being eliminated in the feces, and none in expired air. The major urinary metabolite of oxamyl is the β-glucuronide of oxime. Other reported excreted compounds include the oxime metabolite and unmetabolized oxamyl.

Oxamyl has been shown to have extremely high acute toxicity with oral administration in mice and rats, with females being slightly more sensitive. Symptoms associated with acute exposure are generally consistent with those associated with cholinesterase inhibition and include heavy breathing, fasciculations, salivation, lacrimation, tremors and weight loss. Via inhalation, oxamyl is moderately toxic. With acute dermal exposure, oxamyl is slightly to moderately toxic depending on species and vehicle used. Symptoms arising from inhalation and dermal exposure are similar to those resulting from oral exposure. With respect to both eye irritation and dermal irritation, oxamyl is considered to be mildly irritating and did not elicit a skin sensitization reaction.

The most sensitive endpoints associated with repeat dose oral subchronic and chronic administration were cholinergic clinical signs, cholinesterase inhibition and decreases in body-weight gain. The repeat dose oral data was not conducive to determining whether differences in sensitivity, with respect to sex or species, may occur. Short-term dermal exposure to oxamyl in the rabbit resulted in cholinesterase inhibition.

In acute and subchronic neurotoxicity studies, various clinical and functional operational battery effects related to neurotoxicity were observed, accompanied by cholinesterase inhibition. All effects were reversible highlighting the short-acting effects typically associated with carbamate inhibitors of cholinesterase.

In developmental and reproductive studies, no sensitivity of the young was seen. Oxamyl was not teratogenic in rat or rabbit developmental studies. Decreased fetal body weight in the presence of maternal body-weight effects was seen in the rat, but no additional developmental effects were observed. In rabbits, no fetal effects attributable to oxamyl exposure were observed in the absence of maternal toxicity, though an increase in resorptions was seen in the presence of maternal toxicity. In reproductive studies, a decrease in body weight as well as body-weight gain in offspring was seen and was accompanied by parental effects including decreased body weight and food consumption, hyper-reactivity and alopecia. At higher doses, effects on offspring viability and number of live pups per litter were seen.

Oxamyl was not genotoxic in in vitro studies assessing gene mutation, chromosome aberration and unscheduled DNA synthesis. These data are consistent with carcinogenicity data, which show that oxamyl is not carcinogenic to the rat. The one available study in the mouse is considered supplemental as an assessment of carcinogenicity due to advanced autolysis occurring in an unacceptably high number of animals across groups and throughout the study. This precluded proper pathological and histopathological examination of minor organs and may have compromised the ability to detect potential precarcinogenic indicators (e.g. hyperplasia, metaplasia) and tumours in minor organs.

Reference doses have been set based on no observed adverse effect levels (NOAELs) for the most sensitive indicator of toxicity, namely acetylcholinesterase inhibition. These reference doses incorporate various uncertainty factors to account for extrapolating between laboratory animals and humans as well as for variability within the human populations and for data uncertainties. Under the new *Pest Control Products Act*, an additional 10-fold factor is required to protect children and pregnant females from relevant endpoints of concern or any database uncertainty regarding a potential for increased sensitivity in these population subgroups. A different factor may be determined to be appropriate on the basis of reliable scientific data. In the case of oxamyl, the 10-fold *Pest Control Products Act* factor has been reduced to 1-fold because additional uncertainty factors have already accounted for database uncertainties (i.e. lack of an adequate carcinogenicity study or lack of a NOAEL).

The toxicology endpoints used in the risk assessment of oxamyl are summarized in Appendix III.

3.2 Occupational and Residential Risk Assessment

3.2.1 Toxicology Endpoint Selection for Occupational and Residential Risk Assessment

For the short- (1 to 30 days) and intermediate-term (1 month to several months) dermal risk assessment, a short-term dermal study in the rabbit was selected. Cholinesterase inhibition (plasma, erythrocyte and brain) was observed in females at a lowest observed adverse effect level (LOAEL) of 75 mg/kg bw/day. The NOAEL in this study was 50 mg/kg bw/day. For the short-term risk assessment, the target margin of exposure (MOE) selected for this study is 100 to account for the standard uncertainty factors of 100-fold for interspecies extrapolation and intraspecies variability. An additional 3-fold uncertainty factor is added to the MOE for the intermediate-term assessment to account for the lack of an adequate carcinogenicity study in the mouse, for a target MOE of 300.

The short- (1 to 30 days) and intermediate-term (1 month to several months) inhalation assessments are based upon an acute 4-hour inhalation study in the rat in which cholinesterase inhibition was measured. Cholinesterase inhibition (plasma, erythrocyte and brain) was observed at a LOAEL of 0.85 mg/kg bw/day where no NOAEL was established. This study was considered appropriate because it was conducted using the relevant route of administration and measured the most sensitive endpoint (i.e. cholinesterase inhibition). A single dose study was considered appropriate because long-term daily exposures are considered as multiple daily exposures, each causing transient inhibition of cholinesterase with resulting potential toxicity. For the short-term risk assessment, the target MOE selected for this study is 300, accounting for standard uncertainty factors of 10-fold for interspecies extrapolation and intraspecies variability as well as an additional 3-fold uncertainty factor to account for the absence of a NOAEL. An additional 3-fold uncertainty factor is added to the MOE for the intermediate-term assessment to account for the lack of an adequate carcinogenicity study in the mouse, for a target MOE of 1000.

3.2.2 Occupational Exposure and Risk Assessment

Workers can be exposed to oxamyl when mixing, loading or applying the pesticide, or when re-entering a treated site to conduct activities such as handling treated crops.

3.2.2.1 Mixer/Loader/Applicator Exposure and Risk Assessment

There are potential exposures to mixers, loaders, applicators and other handlers. Based on typical use pattern, the major scenarios identified were as follows:

- Groundboom application on potatoes, raspberries (soil drench) and non-bearing apple trees (soil drench);
- Airblast (foliar) application on non-bearing apple trees; and
- Low-pressure handwand and backpack application in raspberries (soil drench) and non-bearing apple trees (soil drench).

Based on the number of applications per season, workers applying oxamyl would generally have a short-term duration of exposure (< 30 days). The exception would be for groundboom application in potatoes (custom applicator only), which could represent an intermediate-term duration of exposure (> 30 days–6 months).

The PMRA estimated handler exposure based on different personal protection equipment (PPE):

- Mid-level PPE—coveralls over a long-sleeved shirt and long pants, chemical-resistant gloves, with and without respirator.

- Maximum PPE or engineering controls—chemical-resistant coveralls over a long-sleeved shirt and long pants, chemical-resistant gloves and a respirator with open cab or single layer of clothing and closed cab; closed mixing loading wearing coveralls and gloves were also considered when necessary.

Mixer/loader/applicator exposure estimates are based on the best available data at this time. The assessment might be refined with exposure data more representative of modern application equipment and engineering controls. Biological monitoring data might also further refine the assessment.

As no chemical-specific handler exposure data were submitted for oxamyl, dermal and inhalation exposures were estimated using data from the Pesticide Handlers Exposure Database (PHED), Version 1.1. The PHED is a compilation of generic mixer/loader applicator passive dosimetry data with associated software that facilitates the generation of scenario-specific exposure estimates based on formulation type, application equipment, mix/load systems and level of PPE. The PHED did not contain appropriate data sets to estimate exposure in workers wearing chemical-resistant coveralls or a respirator. This was estimated by incorporating a 90% clothing protection factor for chemical-resistant coveralls and a 90% protection factor for a respirator into the unit exposure data.

For oxamyl, the adverse toxicological endpoints (cholinesterase inhibition) are the same for both exposure routes (dermal and inhalation) and durations of exposure (short- and intermediate-term). As such, risks from both routes should be combined. However, the target MOEs for the dermal and inhalation routes for the short- and intermediate-term risk assessments are different (short-term 100 and 300 for the dermal and inhalation routes, respectively, and intermediate-term, 300 and 1000 for the dermal and inhalation routes, respectively). Where the target MOEs for exposure routes differ, an aggregate risk index (ARI) is calculated as a measure of combined risk.

An ARI of one indicates target MOEs are met; therefore, if an ARI of less than one is calculated, further mitigation options should be investigated. To calculate an ARI, route-specific risk indices (RI) are calculated using the calculated MOEs and target MOE. The RIs and subsequent ARI are calculated as follows.

$$RI_{dermal} = \text{calculated } MOE_{dermal} / \text{target } MOE_{dermal}$$

$$RI_{inhalation} = \text{calculated } MOE_{inhalation} / \text{target } MOE_{inhalation}$$

$$ARI = \frac{1}{1/RI_{dermal} + 1/RI_{inhalation}}$$

Calculated ARIs exceed 1 for application, mixing and loading for the majority of label uses, provided personal protective equipment or engineering controls are used as summarized in Appendix IV, Table 1.

Proposed mitigation measures and regulatory actions are described in Section 7.0.

3.2.2.2 Postapplication Exposure and Risk Assessment

The postapplication occupational risk assessment considered exposures to workers entering treated sites. Based on the use pattern, there is potential for short-term (1–30 days) postapplication exposure for activities associated with raspberries as well as thinning and hand-line irrigation of non-bearing apple trees. Intermediate-term (1–6 months) postapplication exposure is possible for activities such as scouting potatoes as well as other activities associated with non-bearing apple trees (pruning, scouting, training, weeding and propping).

Dislodgeable foliar residue data are used to estimate postapplication exposure resulting from contact with treated foliage at various times after application. Chemical-specific dislodgeable foliar residues studies were used for estimating the dissipation of oxamyl residues following application.

For workers entering a treated site, restricted-entry intervals (REIs) are calculated. An REI is the duration of time that must elapse before residues and/or air concentrations decline to a level at which entry into a treated area to perform a specific activity results in exposures above the target MOE (i.e. > 100 for short-term and > 300 for intermediate-term dermal risk assessments). Postapplication risks are summarized in Appendix IV, Table 2.

The following REIs have been calculated:

Raspberries:	3 days
Potatoes:	3 days
Apples (non-bearing):	1 day

As refinements to the postapplication risk assessment, chemical-specific dislodgeable foliar residue studies were applied to Canadian crops. A conservative aspect of the postapplication assessments may include the use of dislodgeable foliar residue data from California, which may overestimate residue levels in Canadian climatic conditions.

3.2.3 Residential Exposure and Risk Assessment

Oxamyl is not registered for residential uses; therefore, residential exposure and risks were not considered.

3.3 Dietary Exposure and Risk Assessment

In a dietary exposure assessment, the PMRA determines how much pesticide residues, including residues in milk and meat, may be ingested with the daily diet. Exposure to oxamyl from treated imports is also included in the assessment. These dietary assessments are age-specific and incorporate the different eating habits of the population at various stages of life. For example, the assessments take into account differences in children's eating patterns, such as food preferences and the greater consumption of food relative to their body weight when compared to adults. Dietary risk is then determined by comparing the dietary intake to the reference doses established in the toxicity assessments.

Residue estimates used in the dietary risk assessment may be conservatively based on the maximum residue limits (MRLs) or on field trial data, which are representative of the residues that may remain on food after treatment at the maximum label rate. Surveillance data representative of the national food supply may also be used to derive a more accurate estimate of residues that may remain on food when it is purchased. These include the Canadian Food Inspection Agency's National Chemical Residue Monitoring Program and the United States Department of Agriculture Pesticide Data Program.

Acute and chronic dietary exposure and risk estimates were generated using Dietary Exposure Evaluation Model (DEEM®) software and updated consumption data from the United States Department of Agriculture's Continuing Survey of Food Intakes by Individuals (1994–1998).

3.3.1 Acute Dietary Exposure and Risk Assessment

Acute dietary risk is calculated considering the highest ingestion of oxamyl that would be likely on any one day based on consumption and food residue values. A probabilistic statistical analysis examines all possible combinations of consumption and residue levels to estimate a distribution of the amount of oxamyl residue consumed in a day. A value representing the high end (99.9^{th} percentile) of this distribution is compared to the acute reference dose (ARfD), which is the dose at which an individual could be exposed on any given day and expect no adverse health effects. When the highest ingestion (99.9^{th} percentile) of residues is less than the ARfD, acute risk is not considered to be of concern.

The estimate of risk associated with acute dietary exposure to oxamyl was based on an acute neurotoxic screening study in the rat with a NOAEL of 0.1 mg/kg bw (Appendix III). At the LOAEL of 1.0/0.75 mg/kg bw (male/female, respectively), effects included clinical signs, inhibition of plasma, brain and erythrocyte cholinesterase as well as neurological effects detected by the functional observational battery. Standard uncertainty factors of 10 for intraspecies variability and 10 for interspecies extrapolation were applied for a total uncertainty factor of 100. The ARfD was calculated to be 0.001 mg/kg bw. This value is considered protective of all populations including infants and children.

The acute dietary risk assessment (Appendix V, Table 1) shows none of the population groups exceeds the level of concern, which is 100% of the ARfD. Infants and young children are the most exposed subpopulation. Analysis of food residue data show that imported, processed apples and tomatoes are critical contributors to infant diet.

3.3.2 Chronic Dietary Exposure and Risk Assessment

The chronic dietary risk is calculated by using the average consumption of different foods and the average residue values on those foods. This expected intake of residues is compared to the acceptable daily intake (ADI), which is the dose at which an individual could be exposed over the course of a lifetime and expect no adverse health effects. When the expected intake from residues is less than the ADI, chronic risk is not considered to be of concern.

The quick acting and reversible nature of carbamate cholinesterase inhibition was considered justification to default to the acute NOAEL, which is lower than the subchronic or chronic NOAEL. Furthermore, in the case of oxamyl, long-term daily exposures were considered as multiple daily exposures, each causing transient inhibition of cholinesterase with resulting potential toxicity. The ADI was, therefore, set at 0.001 mg/kg bw/day, the same as the ARfD (Appendix III).

Appendix V, Table 1, shows chronic dietary risk to be less than 5% of the ADI for all populations. The PMRA, therefore, concludes that contribution of oxamyl to chronic dietary risk is acceptable.

3.3.3 Drinking Water Exposure

The drinking water level of comparison (DWLOC) is the maximum concentration of pesticide in water that would bring the total risk (dietary + water) to 100% of the reference dose; it can only be determined if all other sources of exposure are acceptable. This quantity is compared to model predictions of water concentrations, considering both acute and chronic exposure. Model predicted expected environmental concentrations (EECs) may raise concern when they exceed the DWLOC.

In the case of oxamyl, acute and chronic EECs were calculated for the treatment of apple and potato, taking into account geographical distribution of crops. Residues in groundwater are not expected; however, residues may appear in surface waters. Appendix V, Table 2, shows that chronic surface water concentrations were not of concern but that acute concentrations exceeded

the DWLOC for infants and children. However, the acute DWLOC approach may have been too conservative because it relied on a high-end water concentration estimate to protect the entire population.

Rate reductions are proposed and incorporated into the risk assessment to further reduce potential exposure via drinking water. The PMRA refined the analysis with a probabilistic approach where water exposure to each population subgroups was evaluated using a distribution of daily water concentrations for the most significant scenario of 2 foliar applications on potatoes at 0.72 kg a.i./ha . The EECs were reduced to 23% of their value to approximate the fraction of watershed actually affected. This estimate is based on best appraisal of crop production and geographical distribution of potato farming. Appendix V, Table 3, shows that risk at the 99.9th percentile for most sensitive populations of infants and children stands near 80% and is, therefore, below levels of concern.

3.4 Aggregate Exposure and Risk Assessment

Aggregate exposure is the total exposure to a single pesticide that may occur from food, drinking water, residential and other non-occupational sources as well as from all known or plausible exposure routes (oral, dermal and inhalation). As there are no residential uses of oxamyl, aggregate exposure is covered by the dietary and drinking water assessment. As noted in Sections 3.3.2 and 3.3.3, chronic and acute aggregate exposures are acceptable.

4.0 Environmental Assessment

In characterizing the environmental risk of oxamyl, the PMRA used a deterministic approach that characterizes the risk by quotient method. In this method, a risk quotient (RQ) is calculated as the ratio of the EEC to the toxicity endpoint of concern, usually a no observed effect concentration (NOEC) for the most sensitive test species. Where a NOEC is not available for a test organism, one-tenth of a lethal concentration 50% (LC_{50}) is used. RQs less than one are considered as a low risk to non-target organisms, whereas, RQs greater than one indicate some degree of risk. Where possible, the risk assessments were refined using less conservative assumptions when a risk was identified during the preliminary screening level assessment and exposure is assumed to be 100% of the application rate.

For the spray formulations of oxamyl, initial and cumulative EECs were calculated for soil, water and wildlife food sources. A range of application rates was used to calculate the EECs, along with the maximum number of applications and minimum intervals between applications. The cumulative EECs were estimated by adjusting the sum of the applications for dissipation between applications using the time for 50% decline (DT_{50}) for the appropriate environmental media. To assess the risk to aquatic organisms from runoff, concentrations of oxamyl were predicted using the Pesticide Root Zone Model and Exposure Analysis Modeling System (PRZM/EXAMS). Effects endpoints included both acute and chronic, chosen from the range of toxicity tests on species available. Effects endpoints, chosen from the most sensitive species, were used as surrogates for the wide range of species that can be potentially exposed following treatment with oxamyl.

4.1 Environmental Fate

Oxamyl is very soluble in water (280 g/L). It is non-volatile (vapour pressure 3.8×10^{-7} mm Hg) and unlikely to volatilize from moist soil or water as indicated by Henry's law constant of 3.8×10^{-13} atm m^3/mole. The *n*-octanol–water partition coefficient, log $K_{ow} < 1$, indicates that oxamyl has no potential for bioaccumulation.

Hydrolysis is an important transformation pathway of oxamyl under neutral and basic conditions (half-life of 8 days and 3 hours at pH 7 and 9, respectively). Oxamyl is stable to hydrolysis under acidic conditions (half-life > 30 days at pH 5). The aquatic phototransformation half-life is less than 7 days at pH 5.

Oxamyl is moderately persistent in the environment. The reported half-lives of oxamyl in soil were 11–27 days and 6–7 days under aerobic and anaerobic conditions, respectively. The organic carbon partition coefficients, K_{oc} = 6–12, indicate that oxamyl has a low affinity to soils. Under field conditions, oxamyl is expected to be highly mobile in soil. Oxime was the major transformation product from hydrolysis and aquatic phototransformation.

No data on aquatic biotransformation were available for review.

4.2 Environmental Toxicology

Laboratory studies demonstrated that oxamyl is acutely and chronically toxic to a wide variety of organisms, including birds, mammals, fish and aquatic invertebrates.

Oxamyl is highly toxic to honeybees (lethal dose 50% (LD_{50}) 0.31 µg a.i./bee). It is highly toxic to birds (LD_{50} 3.16 mg a.i./kg) on an acute basis and moderately toxic (LC_{50} 340–766 mg a.i./kg) on a dietary basis. Adverse reproductive effects were observed at or above 50 mg a.i./kg diet based on a reduction of egg production and egg fertility (NOEC 10 mg a.i./kg) in the mallard duck study. No adverse reproductive effects were observed in bobwhite quail study. Oxamyl is highly toxic to mammals on an acute (LD_{50} 2.5–3.1 mg a.i./kg) and chronic (no observed effect level [NOEL] 25 mg a.i./kg, reproduction) basis.

Oxamyl is moderately to highly toxic to freshwater invertebrates (LC_{50} 0.18–5.7 mg a.i./L) and slightly to moderately (LC_{50} 3.7–27.5 mg a.i./L) toxic to freshwater fish on an acute basis. Early life-stage toxicity tests under flow-through conditions conducted with rainbow trout and fathead minnow show that oxamyl affected larval survival at concentration greater than 0.5 mg a.i./L. Oxamyl is moderately to highly toxic to estuarine/marine invertebrates (LC_{50} 0.4–2.9 mg a.i./L) and moderately toxic to fish (LC_{50} 2.6 mg a.i./L).

4.3 Drinking Water Concentrations

Residues of oxamyl in drinking water sources in Canada were estimated using the Leaching Estimation and Chemistry Model (LEACHM) and PRZM/EXAMS. LEACHM was used to estimate the residues in ground water, whereas the residues in dugouts and reservoirs were estimated using PRZM/EXAMS. For residues in ground water, the acute and chronic

concentrations were estimated to be 0.00038 and 0.00538 µg a.i./L, respectively. For dugouts, the acute and chronic exposure concentrations were estimated to be 63.2 and 2.4 µg a.i./L, respectively. For residues in reservoirs, the acute and chronic exposure concentrations were estimated to be 14.5 and 0.479 µg a.i./L, respectively. Reservoir concentration values are the results of refined Level 2 assessment based on actual uses of oxamyl (lower application rates and fewer applications per season, e.g. 3 × 1.68 and 2 × 0.72 kg a.i./ha for non-bearing apple trees and potatoes, respectively).

A search for Canadian oxamyl water monitoring data revealed that routine analysis for oxamyl is not conducted. Given the lack of data available in Canada for residues of oxamyl in water, databases from the United States were searched for detections of oxamyl in water. The USEPA's Pesticides in Groundwater Database indicated that oxamyl was detected at concentration ranging from 0.01 to 395 µg/L. The Storage and Retrieval (STORET) database reported detections of oxamyl in surface water with concentrations ranging from 0.07–0.7 µg/L with a mean of 0.23 µg/L.

4.4 Terrestrial Assessment

The results of a screening assessment identified various levels of risk to non-target terrestrial organisms exposed to oxamyl. The RQs are calculated for the range of recommended application rates (minimum and maximum) on the label.

Based on the acute contact toxicity (LD_{50} 0.35 kg a.i./ha), high acute risk to bees is anticipated from oxamyl application to crops in blossom (RQ 12–48). The extent of the residual hazard will vary with application rate, weather conditions and the formulation of the specific product applied.

Based on the acute oral toxicity of oxamyl to birds (NOEL 0.16–0.316 mg a.i./kg) and using standard PMRA exposure scenarios, it was determined that small birds (e.g. field sparrow, American robin) and large birds (e.g. mallard duck) would have to consume contaminated food sources for 0.002–0.009 and 0.08–0.3 days, respectively, to reach the NOEL. To reach the LD_{50}, small and large birds would have to consume contaminated food sources for 0.02–0.09 and 0.8–3 days, respectively. As the number of feeding days that would kill 50% of the individuals is less than one (exception being lower application rates in case of large birds), there is an acute risk for birds consuming contaminated food sources. On a subacute dietary basis, (NOEL 34 mg a.i./kg) the risk associated with exposure to oxamyl for birds is moderate to high (RQ 2.1–8.7). The risk determined for birds from chronic exposure to oxamyl (NOEC 10 mg a.i./kg; reproduction) is moderate (RQ 1.4–5.7).

Based on the acute oral toxicity of oxamyl to small mammals (NOEL 0.25 mg a.i./kg) and using standard PMRA exposure scenarios, it was determined that animals would have to consume contaminated food sources for 0.003–0.01 day to reach the NOEL and 0.03–0.1 day to reach the LD_{50}. As the number of feeding days that would kill 50% of the individuals is less than one, there is an acute risk to small mammals consuming contaminated food. Chronic toxicity data (NOEC 25 mg a.i./kg; reproduction) indicate that oxamyl would pose high chronic risk (RQ 8.3–33.8) to small mammals.

4.5 Aquatic Assessment

The results of a screening assessment (100% deposition in water 30-cm deep) identified various levels of risk to non-target aquatic organisms exposed to oxamyl.

The screening level risk assessment indicated that the threshold of acute and chronic effects for aquatic organisms are exceeded at some application rates. This screening assessment triggered the assessment of the need for buffer zones in order to protect aquatic organisms from spray drift entering the aquatic environment and the determination of concentrations in near field aquatic systems resulting from runoff.

The potential for effects resulting from drift was examined by determining the percentage of the application rate required to reach the threshold of effects for freshwater invertebrates and fish. Upon consideration of the most sensitive aquatic organism, the percentage of drift from a single application that would result in EECs that exceed the threshold of effects would be 2.4% of the application rate. Thus, to protect the non-target aquatic organisms, buffer zones are required and were determined based on the endpoint for effects on freshwater midge (NOEC 18 µg a.i./L) and estuarine/marine eastern oyster (NOEC 40 µg a.i./L). The calculated buffer zones for aquatic habitats are presented in Appendix VI.

EECs of oxamyl resulting from runoff to near field aquatic habitats in specific crop related scenarios were predicted by the PRZM/EXAMS model. The 90th percentile (1 in 10 year) 96-hour yearly peak from the location that predicted the highest EECs was used in the acute risk assessment. The 90th percentile (1 in 10 year) 21-day yearly peak from the location that predicted the highest EECs was used in the chronic risk assessment for aquatic invertebrates, and the 90th percentile (1 in 10 year) yearly average was used in the chronic assessment for fish. Using the most sensitive endpoint for each species group (i.e. freshwater invertebrates, freshwater fish, estuarine/marine invertebrates, estuarine/marine fish), it was determined that freshwater invertebrates are at moderate risk (RQ 8) of acute adverse effects and at no risk (RQ 0.005) of chronic adverse effects from 1 in 10 year EECs predicted for runoff. Estuarine/marine invertebrates are at moderate acute risk (RQ 3.6) from exposure to 1 in 10 year EECs predicted for runoff. The calculated RQs for freshwater fish exposed to the 1 in 10 year concentrations predicted from runoff indicate that freshwater and estuarine/marine fish are at low risk (RQ 0.3 and 0.5, respectively) from acute exposure to oxamyl. The early life-stage RQ was 0.01, indicating that fish are at no risk of effects during the early life-stage when exposed to the 1 in 10 year concentrations predicted by PRZM/EXAMS.

4.6 Environmental Assessment Conclusions

For terrestrial organisms, high risk was determined for bees (RQ 12-48) and high levels of acute risk to birds and mammals. There is moderate to high subacute dietary risk (RQ 2.1–8.7) and moderate chronic (reproduction) risk (RQ 1.4–5.7) to birds and high chronic (reproduction) risk to small mammals (RQ 8.3–33.8). Mitigation of potential impacts on terrestrial ecosystems is difficult given that the non-target organisms can frequent treated areas. For birds and small mammals, the risk is based on the assumption that they eat 100% contaminated diet, which is not likely. However, given the magnitude of the RQ, acute and chronic risk would still be posed if only 10% of the diet will be contaminated.

For aquatic organisms, the risk assessment indicated that oxamyl poses a potential risk from spray drift to aquatic invertebrates and fish. There is a moderate to high acute risk (RQ 3.4–42.7) for aquatic invertebrates and low to moderate risk (RQ 0.3–3) for fish. Oxamyl in runoff was also identified to pose a moderate acute risk (RQ 2.7–6) for aquatic invertebrates. The risk to non-target aquatic organisms from spray drift can be mitigated by specification of buffer zones. Mitigation of runoff exposure will be through label advisory statements.

4.7 Environmental Risk Mitigation

Mitigation of potential impacts on terrestrial ecosystems is difficult given that the non-target organisms frequent treated areas. In the case of bees, it may be possible to reduce the risk by restricting the application of oxamyl to when bees are not actively foraging. For birds and small mammals, no effective options are available to reduce the risk that results from ingestion of contaminated food sources in treated areas.

Oxamyl can enter aquatic ecosystems through spray drift. The observance of buffer zones, however, can effectively mitigate the risk to off-site non-target organisms. Based on the spray drift predictions and the most sensitive toxicity endpoint, buffer zones for different depth (< 1, 1 to 3 and > 3 m) of waterbody were calculated for mitigating the entry of oxamyl into aquatic habitats (Appendix VI).

Oxamyl can also enter aquatic systems through surface runoff. Currently, there is uncertainty with respect to the efficiency of methods for mitigating the transport of pesticide transport in surface runoff. There are, however, advisory statements with regard to precautionary measures that should be included on product labels to minimize the risk of aquatic contamination from surface runoff. No terrestrial buffer zones are required.

To mitigate oxamyl impact on non-target aquatic habitats from spray drift, buffer zones must be observed (Appendix VI).

5.0 Value

Root Lesion Nematode Control on Apple and Raspberry

Apple
No alternative active ingredients are registered to control root lesion nematode on established apple trees or on young apple trees after planting. The only alternative to oxamyl is to perform soil fumigation prior to planting a new orchard. For established orchards, the only alternative is to rip out the established trees, fumigate the soil and re-establish the orchard. It can take several years for newly planted apple trees to bear fruit.

Raspberry
This use was registered in 1987 as a User Requested Minor Use Label Expansion (URMULE). As with apples, no alternatives to oxamyl are registered to control root lesion nematodes on established raspberry plants. The only alternative is to perform soil fumigation prior to planting a new raspberry crop. For existing raspberry crops, the plants must be removed, the soil fumigated, and the crop must be either re-established or rotated to a crop that is not susceptible to root lesion nematode.

Registered Alternative Active Ingredients (Soil Fumigants) for Control of Root Lesion Nematode on Apples and Raspberries
The registered alternative active ingredients to control root lesion nematode on apples and raspberries are the soil fumigants 1,3-dichloropropene, chloropicrin and metam. These chemicals are toxic to plants; thus, they are registered for application to the soil prior to planting. 1,3-dichloropropene is currently under re-evaluation while chloropicrin and metam were proposed for re-evaluation in Re-evaluation Note REV2005-04, *PMRA Re-evaluation Program (April 2005 to June 2009)*.

6.0 Other Assessment Considerations

6.1 Toxic Substances Management Policy

Oxamyl was assessed against the federal government's Toxic Substances Management Policy and was determined not to meet the Policy Track 1 criteria.

6.2 Formulant Issues

Products containing oxamyl are subject to all the requirements of Regulatory Directive DIR2004-01, *PMRA Formulants Program*, published on 9 January 2004.

7.0 Proposed Regulatory Action

The PMRA has re-evaluated the available information on the active ingredient oxamyl and is proposing that the use of oxamyl and its end-use products is acceptable for continued registration, with the implementation of additional mitigation measures to further protect workers and the environment.

7.1 Proposals Pertaining to Toxicology

The toxicological information must be expanded and/or standardized as described in Appendix VI.

7.2 Proposals Pertaining to Occupational/Residential Exposure

The occupational worker application and postapplication risks are acceptable provided that specific mitigation measures are implemented.

- Personal protective equipment (coveralls over long pants and a long-sleeved shirt, chemical-resistant gloves, chemical-resistant footwear plus socks, goggles, chemical-resistant apron and respirator) is required when handling product.
- Custom application on potatoes requires closed mix/load equipment (with coveralls and gloves) and closed cab ground application equipment when handling more than 110 kg a.i./day.
- An REI of 1 day for non-bearing apple trees and 3 days for raspberries and potatoes must be observed.
- The number of applications will be restricted to two per season for potatoes and three per year for non-bearing apple trees.

7.3 Proposals Pertaining to Dietary Exposure

7.3.1 Residue Definition

The residue definition for oxamyl has not been established. The USEPA and Food and Agriculture Organization define the residue of concern as oxamyl and its oxime metabolite, expressed as oxamyl because analytical methods cannot separate the two species. As the oxime does not cause cholinesterase inhibition, the PMRA proposes to identify the residue definition as oxamyl [IUPAC: N,N-dimethyl-2-methylcarbamoyloxyimino-2-(methylthio)acetamide]. This definition is inclusive of the toxicity of all of oxamyl's metabolites.

7.3.2 Maximum Residue Limits of Oxamyl in Food

In general, when the re-evaluation of a pesticide has been completed, the PMRA intends to update Canadian MRLs and to remove MRLs that are no longer supported. The Agency recognizes, however, that interested parties may want to retain an MRL in the absence of a Canadian registration to allow legal importation of treated commodities into Canada. The PMRA requires similar chemistry and toxicology data for such import MRLs as those required to support Canadian food use registrations. In addition, the PMRA requires residue data that are representative of use conditions in exporting countries, in the same manner that representative residue data are required to support domestic use of the pesticide. These requirements are necessary so that the Agency may determine whether the requested MRLs are needed and to ensure they would not result in unacceptable health risks.

The supported food uses of oxamyl are for apple, raspberry and potato crops. No significant residues are expected to transfer to livestock when using feed containing treated potatoes.

There are presently no set maximum residue limits for oxamyl. Subsection B.15.002(1) applies when no specific MRL for a pest control product has been established in the Food and Drug Regulations. This requires residues not to exceed 0.1 ppm and has been considered a general MRL for enforcement purposes. Currently, residues of oxamyl in all agricultural commodities, including those approved for treatment in Canada, are regulated by this subsection. However, changes may be implemented in the future, as indicated in Discussion Document DIS2003-01, *Revocation of the 0.1 ppm General Maximum Residue Limit for Food Pesticide Residues [Regulation B.15.002(1)]*.

As it has been determined that residues of oxamyl in or on food do not pose a health risk, a transition strategy will be established to allow permanent MRLs to be promulgated if and when the general MRL is revoked.

7.4 Proposal Pertaining to Drinking Water

Proposal for Rate Reduction
In refining potential risk arising from drinking water, the PMRA characterized use information for oxamyl provided by the registrant. This use information was used in the risk assessment including a reduction of the maximum application rate for foliar application to non-bearing apples from 2.244 kg a.i./ha to 1.68 kg a.i./ha. As a result, the PMRA is proposing that the maximum application rate for foliar application to non-bearing apples must be reduced to 1.68 kg a.i./ha.

7.5 Proposals Pertaining to Environment

To mitigate potential risks to the environment, additional label statements including environmental hazards and buffer zones to protect sensitive habitats are proposed in Appendix VI.

8.0 Additional Data Requirements

8.1 Additional Data Requirements Related to Toxicology

The following data are required as a condition of continued registration under Section 12 of the *Pest Control Products Act*. The registrants are required to provide these data or an acceptable scientific rationale within the timeline specified in the decision letter.

DACO 4.4.3 Oncogenicity study (mouse)

8.2 Data Requirements Related to the Dietary Exposure Assessment

Sufficient data are available to assess the dietary risks from the existing use pattern; however, additional data may be required to support any expansion of use.

9.0 Proposed Re-evaluation Decision

Health Canada's PMRA has re-evaluated the available information on the active ingredient oxamyl and the associated end-uses on terrestrial food crops. The PMRA is proposing that the use of oxamyl and its end-use products is acceptable for continued registration, with the implementation of additional mitigation measures to further protect workers and the environment.

List of Abbreviations

λ	wavelength
µg	microgram(s)
ADI	acceptable daily intake
a.i.	active ingredient
ASABE	American Society of Agricultural and Biological Engineers
ARfD	acute reference dose
ARI	aggregate risk index
atm	atmosphere(s)
bw	body weight
CAS	Chemical Abstracts Service
cm	centimetre(s)
DACO	data code
DEEM™	Dietary Exposure Evaluation Model
DER	Data Evaluation Report
DNA	deoxyribonucleic acid
DT_{50}	dissipation time to 50%
DWLOC	drinking water level of comparison
EEC	expected environmental concentration
EXAMS	Exposure Analysis Modeling System
g	gram(s)
ha	hectare
IRED	Interim Reregistration Eligibility Decision
IUPAC	International Union of Pure and Applied Chemistry
kg	kilogram(s)
K_{oc}	organic carbon partition coefficient
K_{ow}	*n*-octanol–water partition coefficient
L	litre(s)
LEACHM	Leaching Estimation and Chemistry Model
LC_{50}	lethal concentration to 50%
LD_{50}	lethal dose to 50%
LOAEL	lowest observed adverse effect level
m	metre(s)
mg	milligram(s)
mm Hg	millimetre mercury
mPa	millipascal(s)
MOE	margin of exposure
mol	mole
MRL	maximum residue limit
NIOSH	National Institute for Occupational Safety and Health
nm	nanometre(s)
NOEC	no observed effect concentration
NOAEL	no observed adverse effect level
NOEL	no observed effect level
Pa	Pascal(s)
pH	-log10 hydrogen ion concentration

PHED	Pesticide Handlers Exposure Database
p*K*a	-log10 acid dissociation constant
PMRA	Pest Management Regulatory Agency
PPE	personal protective equipment
ppm	parts per million
PRZM	Pesticide Root Zone Model
REI	restricted-entry interval
RI	risk index
RQ	risk quotient
SF	safety factor
STORET	STORage and RETrieval (database)
UF	uncertainty factor
URMULE	User Requested Minor Use Label Expansion
USC	use-site category
USEPA	United States Environmental Protection Agency

Appendix I Oxamyl Products Currently Registered (excluding discontinued products or products with a submission for discontinuation) as of 6 January 2006

Registration Number	Marketing Class	Registrant	Product Name	Formulation Type	Guarantee
24949	Technical	E.I. DuPont Canada Company	Oxamyl Technical	Solution	240 g a.i./L
17995	Restricted	E.I. DuPont Canada Company	Vydate L Insecticide/Nematicide	Solution	240 g a.i./L

Appendix II Registered Canadian Uses of Oxamyl as of 6 January 2006

Site(s)	Pests(s)	Application Methods and Equipment	Application Rate (g a.i./ha)		Maximum Number of Applications per Year	Minimum Number of Days Between Applications
			Maximum Single	Maximum Cumulative		
Use-Site Category 14 : Terrestrial Food Crops						
Apple (non-bearing)	Root lesion nematode	Soil drench: conventional ground equipment	Soil drench application: 1 g a.i./tree (super spindle or spindle trees: 4 355 trees/ha) 2 g a.i./tree (dwarf: 980–1480 trees/ha) 3 g a.i./tree (semi-dwarf trees: 117–740 trees/ha) (large and medium trees: 75–125 trees/ha)	4355	1	Not applicable
		Foliar spray: conventional ground equipment	2244	6732	3	14
		Concurrent soil drench and foliar application: conventional ground equipment	See above for details on maximum single application rates	Concurrent soil drench (4355) and foliar (2244) application 6599	1	Not applicable
Apple (non-bearing)	Apple rust mite, European red mite, green apple aphid, leafhoppers, leafrollers, rosy apple aphid, tarnished plant bug, tentiform leafminers, two-spotted spider mite	Foliar spray: conventional ground equipment	2244	Not able to calculate as no limit to the number of applications is identified on the product label	Not stated on the product label	Not stated on the product label
Potato	Colorado potato beetle, flea beetles, green peach aphid, potato aphid, potato leafhopper, tarnished plant bug	Foliar spray: conventional ground equipment	720	Not able to calculate as no limit to the number of applications is identified on the product label	Not stated on the product label	7
Raspberry	Root lesion nematode	Soil drench: conventional ground equipment	2244	2244	1	Not applicable

All uses are supported by the registrant.

Appendix III Toxicology Endpoints for Oxamyl Health Risk Assessment

Exposure Scenario	Endpoint	Study	Dose	UF/SF or MOE[a]
Acute Dietary	Cholinesterase Inhibition	Acute Neurotoxicity—Rat	0.1 mg/kg bw	100
	ARfD = 0.001 mg/kg bw			
Chronic Dietary	Cholinesterase Inhibition	Acute Neurotoxicity—Rat	0.1 mg/kg bw/day	100
	ADI = 0.001 mg/kg bw/day			
Short-Term[b] Dermal	Cholinesterase Inhibition	3-Week Dermal Toxicity—Rabbit	50 mg/kg bw/day	100
Intermediate-Term[c] Dermal	Cholinesterase Inhibition	3-Week Dermal Toxicity—Rabbit	50 mg/kg bw/day	300
Short[b]-Term Inhalation	Cholinesterase Inhibition	Acute Inhalation	0.85 mg/kg bw/day (LOAEL)	300
Intermediate-Term[c] Inhalation	Cholinesterase Inhibition	Acute Inhalation	0.85 mg/kg bw/day (LOAEL)	1000

[a] UF/SF refers to total of uncertainty and/or safety factors for dietary assessments, MOE refers to desired MOE for occupational or residential assessments.

[b] 1 to 30 days.

[c] One month to several months.

Appendix IV Occupational Exposure Estimates

Table 1 Occupational Mixer/Loader/Applicator Exposure and Risk Assessment

Crop		Method of Application	Rate[a] (kg a.i./ha)	Area Treated[b] (ha/day)	kg a.i. Handled /day	Dermal MOE[c]	Inhalation MOE[d]	ARI[e]
Short-Term Risk Assessment								
PPE: Coveralls over a single layer of clothing (long-sleeved shirt, long pants), chemical-resistant gloves and respirator (open mixing/loading, open cab application)								
Raspberries		Groundboom	2.24	30	67.2	968	3459	5.3
		Low-pressure handwand		2	4.48	1063	2938	5.1
		Backpack				301	2139	2.1
Non-bearing apple trees	Foliar application	Airblast	1.68	16	26.88	250	2991	2
	Liquid drench	Groundboom	4.6	16	73.6	884	3158	4.8
		Low-pressure handwand	0.0003 kg a.i./L	150 L/day	0.045	105 788	292 527	507
		Backpack				29 948	212 918	211
Potatoes		Groundboom	0.72	100	72	903	3228	4.9
				300	216	301	1076	1.6
Intermediate-Term Risk Assessment (only considered relevant for custom application to potatoes)								
PPE: Coveralls over a single layer of clothing (long-sleeved shirt, long pants), chemical-resistant gloves and respirator (open mixing/loading, open cab application)								
Potatoes		Groundboom	0.72	300	216	301	1076	0.5
Maximum PPE: Chemical-resistant coveralls, chemical-resistant gloves and respirator (open mixing/loading, open cab application)								
Potato		Groundboom	0.72	300	216	339	1076	0.6
				153	110	590	2110	1
Engineering Controls: Closed mix/load, closed cab (coveralls and gloves worn during mixing/loading)								
Potato		Groundboom	0.72	300	216	784	1620	1

[a] Maximum label rate. All rates in kg a.i./ha unless otherwise indicated.

[b] Based on default assumptions. All values in units of ha/day, unless otherwise indicated.

[c] Dermal MOE = dermal NOAEL/dermal exposure. The dermal NOAEL is 50 mg/kg bw/day; the short-term dermal target MOE is 100; the intermediate term targer MOE is 300.

[d] Inhalation MOE = inhalation LOAEL/inhalation exposure. The inhalation LOAEL is 0.85 mg/kg bw/day. A protection factor of 90% is incorporated into the inhalation exposure estimate to reflect the use of a respirator.
The short-term inhalation target MOE is 300; the intermediate term target MOE is 1000.

[e] Combined ARI = $1/(1/RI_{Dermal} + RI_{Inhalation})$. Where RI_x = calculated MOE_x/target MOE_x. An ARI of less than 1 indicates that further mitigation options are required. Shaded cells indicate when ARIs < 1

Table 2 Postapplication Exposure Estimates, MOEs and REIs for Oxamyl

Activity	Transfer Coefficient	Short-Term Risk Assessment		Intermediate-Term Risk Assessment	
		MOE[a]	Proposed REI[b]	MOE[c]	Proposed REI[d]
Non-bearing apple trees (1.68 kg a.i./ha)					
Weeding, propping	100	1245	0	1245	0
Hand pruning, scouting, training	500	249		808	1
Hand line irrigation	1100	113		N/A	N/A
Thinning	3000	135	1	N/A	N/A
Raspberries (2.24 kg a.i./ha)					
Scouting, irrigation, hand weeding	500	113	0	N/A	N/A
Hand pruning	1500	108	3	N/A	N/A
Potatoes (0.72 kg a.i./ha)					
Hand weeding, irrigation, scouting	300	589	0	589	0
Scouting, irrigation	1500	118		337	3

N/A = not applicable

[a] MOE = dermal exposure/(short-term dermal NOAEL of 50 mg/kg bw/day). Target MOE of 100.

[b] The proposed REI is to reach a target MOE of 100.

[c] MOE = dermal exposure/(intermediate-term dermal NOAEL of 50 mg/kg bw/day). Target MOE of 300.

[d] The proposed REI is to reach a target MOE of 300.

Appendix V Dietary Risk Assessment

Table 1 Acute and Chronic Dietary Risk in the United States and Canada[a]

Population	Acute Risk (% ARfD)	Chronic Risk (%ADI)
General population	40	1
All infants (< 1 year)	76	3
Nursing infants	50	2
Non-nursing infants	77	4
Females 13–19 (not pregnant or nursing)	60	1
Females 20+ (not pregnant or nursing)	21	1
Males 13–19 years	25	1
Males 20+ years	19	1
Children 1–2 years	**79**	**5**
Children 3–5 years	58	3
Children 6–12 years	35	2
Children 7–12 years	32	2
Youth 13–19 years	21	1
Adults 20–49 years	15	1
Adults 50+ years	28	1

[a] For acute risk, values are a percent fraction of acute reference dose set at 0.001 mg/kg bw. For chronic risk, values are a percent fraction of acceptable daily intake (ADI) also set at 0.001 mg/kg bw/day.

Table 2 Drinking Water Level of Comparison for Oxamyl[a]

Population	DWLOC (µg/L)		EEC (µg/L)	
	Chronic	Acute	Chronic	Acute
General population	34.6	**21.0**	1.15 (apple) 0.48 (potato)	29.5 (apple) 14.5 (potato)
All infants <1 year	9.7	**2.3**		
Children 1–6 years	14.3	**3.0**		
Children 7–12 years	19.2	**12.7**		
Females > 20 years	30.8	**24.5**		

[a] Estimates for apple and potato, assuming 100% watershed affected. **Entries in bold** indicate that range of EECs exceeds DWLOC. Groundwater values are of no concern.

Table 3 Probabilistic Estimate of Risk Due to Drinking Water Exposure[a]

Population	Acute Risk (%)		Chronic Risk (%)	
	Water Only	All Sources	Water Only	All Sources
All infants	27	77	0	3
Infants, nursing, < 1 year	13	52	0	2
Infants, non-nursing, < 1 year	31	78	0	4
Children 1–2 year	11	79	0	5

[a] Calculations based on 2 foliar applications on potato at 0.72 kg a.i./ha and evaluated at the 99.9th percentile for most sensitive population. Watershed is assumed affected at 23%. "Water Only" refers to dietary risk arising from exposure to drinking water only. "All Sources" is the sum of drinking water and dietary exposure to potato, raspberry and imported commodities, evaluated at default process factors.

Appendix VI Label Amendments for Commercial Class Products Containing Oxamyl

(**NOTE:** The information presented below does not identify all label requirements for individual end use products such as first aid statements, disposal statements, precautionary statements and supplementary PPE that may be required. Additional information on labels for currently registered products should not be removed unless it contradicts information in summary.)

COMMON NAME: Oxamyl

CHEMICAL NAME: methyl 2-(dimethylamino)-*N*-[[(methylamino)carbonyl]oxy]-2-oxoethanimidothioate

FORMULATION TYPE: Solution

USE-SITE CATEGORY: USC # 14, Terrestrial Food Crops

TOXICOLOGICAL INFORMATION

Oxamyl is a carbamate, which is a cholinesterase inhibitor. Typical symptoms of overexposure to cholinesterase inhibitors include malaise, muscle weakness, dizziness and sweating. Headache, salivation, nausea, vomiting, abdominal pain and diarrhea are often prominent. A life-threatening poisoning is signified by loss of consciousness, incontinence, convulsions and respiratory depression with a secondary cardiovascular component. Treat symptomatically. If exposed, plasma and red blood cell cholinesterase tests may indicate degree of exposure (baseline data are useful). However, if a blood sample is taken several hours after exposure, it is unlikely that blood cholinesterase activities will be depressed, due to rapid reactivation of cholinesterase. Atropine, only by injection, is the preferable antidote. Do not use pralidoxime. In cases of severe acute poisoning, use antidotes immediately after establishing an open airway and respiration. With oral exposure, the decision of whether to induce vomiting or not should be made by an attending physician.

For those products that contain more than 10% petroleum distillates, the following text should also be added to the Toxicological Information section (placed at the end of the paragraph presented above), as an additional aid to the attending physician:

"NOTE: Product contains a petroleum distillate solvent."

PERSONAL PROTECTIVE EQUIPMENT

When mixing/loading, applying or otherwise handling, wear:

- coveralls over a long-sleeved shirt, long pants;
- chemical-resistant gloves;
- chemical-resistant footwear plus socks;
- goggles;
- chemical-resistant apron when cleaning equipment, mixing or loading; and
- a NIOSH-approved respirator.

If handling more than 110 kg oxamyl/day, closed mixing/loading equipment (wearing coveralls and gloves) and closed cab ground application equipment must be used.

RESTRICTED-ENTRY INTERVALS

Raspberries:	3 days
Potatoes:	3 days
Apples (non-bearing):	1 day

ENVIRONMENTAL HAZARDS

TOXIC to bees, birds, mammals and aquatic organisms. Observe buffer zones specified under DIRECTIONS FOR USE.

DIRECTIONS FOR USE

Number of applications:

For potatoes, a maximum of two applications per season is required.
For non-bearing apple trees, a minimum interval of 14 days is required to a maximum of 3 applications per year.

Maximum application rate:

For foliar application on non-bearing apples, the maximum application rate is reduced from 9.35 L/ha (2244 g a.i./ha) to 7.0 L/ha (1680 g a.i./ha).

Field sprayer application: **DO NOT** apply during periods of dead calm. Avoid application of this product when winds are gusty. **DO NOT** apply with spray droplets smaller than the American Society of Agricultural and Biological Engineers (ASABE) [fine or medium or coarse] classification.

Airblast application: **DO NOT** apply during periods of dead calm. Avoid application of this product when winds are gusty. **DO NOT** direct spray above plants to be treated. Turn off outward pointing nozzles at row ends and outer rows. **DO NOT** apply when wind speed is greater than 16 km/h at the application site as measured outside of the treatment area on the upwind side.

DO NOT apply by air.

For application to rights-of-way, buffer zones for protection of sensitive terrestrial habitats are not required; however, the best available application strategies that minimize off-site drift, including meteorological conditions (e.g. wind direction, low wind speed) and spray equipment (e.g. coarse droplet sizes, minimizing height above canopy), should be used. Applicators must observe the specified buffer zones for protection of sensitive aquatic habitats.

Buffer Zones:

The buffer zones specified in the table below are required between the point of direct application and the closest downwind edge of sensitive terrestrial habitats (such as grasslands, forested areas, shelter belts, woodlots, hedgerows, rangelands, riparian areas and shrublands), sensitive freshwater habitats (such as lakes, rivers, sloughs, ponds, prairie potholes, creeks, marshes, streams, reservoirs and wetlands) and estuarine/marine habitats.

Method of Application	Crop	Buffer Zones (metres) Required for the Protection of:					
		Freshwater Habitat of Depths:			Estuarine/Marine Habitats of Depths:		
		Less than 1 m	1–3 m	Greater than 3 m	Less than 1 m	1–3 m	Greater than 3 m
Field sprayer*	potato	2	1	0	1	0	0
	raspberry	3	1	1	2	1	0
Airblast (early growth stage)	non-bearing apple tree	33	21	10	25	13	4
Airblast (late growth stage)		24	14	4	16	6	2

* For field sprayer application, buffer zones can be reduced with the use of drift reducing spray shields. When using a spray boom fitted with a full shield (shroud, curtain) that extends to the crop canopy or ground, the labelled buffer zone can be reduced by 70%. When using a spray boom where individual nozzles are fitted with cone-shaped shields that are no more than 30 cm above the crop canopy or ground, the labelled buffer zone can be reduced by 30%.

When a tank mixture is used, consult the labels of the tank-mix partners and observe the largest (most restrictive) buffer zone of the products involved in the tank mixture.